

## **Progress Report**

**Core Name:** Emerging Chemical Contaminants of Concern

**Project Title:** Emerging Marine Contaminant Research Project

**Reporting Period:** 10/1/05-9/30/06

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### **Background and Rationale:**

Urbanized estuaries have been shown to have elevated contaminant levels in sediments, water and associated biota. The difficulty in making sound assessments of the distribution and bioeffects of these contaminants comes from a lack of detailed understanding of chemical and toxicological interactions in a very complex environment. Many contaminants entering the estuarine environment are not routinely included in existing monitoring programs because of the lack of widely available analytical methods for their detection and quantitation. This means that any risk to estuarine biota or human consumers associated with these unmeasured contaminants cannot be quantified. The challenge for marine environmental analytical chemistry is to develop methodologies to identify and quantify these compounds, their degradation products, and biological metabolites as they enter estuarine waters and are deposited in sediments and/or accumulate in biota. In addition, the potential toxicity of many of the contaminants entering estuarine environments has not been evaluated in resident biota. The toxicological challenge will be to identify appropriate model estuarine organisms and develop sensitive endpoints for study.

Most previous research efforts examining the effects of anthropogenic contamination in urbanized estuaries has focused on persistent priority pollutants, such as trace metals, pesticides, PCBs and PAHs. Recently, concerns have been raised about the fate and effects of pharmaceuticals and other emerging contaminants of concern (ECC) that are being released into coastal watersheds through upland runoff from both urban and agricultural lands, sewage discharges, industrial releases, and aquaculture. In some cases, these releases are pulsed, short-lived events, but they may also be nearly constant for non-persistent chemicals due to the nature of the various sources.

### **Objectives:**

- Identify emerging contaminants of concern in the estuarine environment;
- Develop analytical methods and document the presence of these contaminants in the estuarine/marine environment;
- Determine the distribution of emerging and historical contaminants in sensitive estuarine habitats (eg. tidal creeks);
- Evaluate the effects of these contaminants in estuarine organisms and their potential to impact human health; and

- Develop a comprehensive Risk Assessment for the identified contaminants in the estuarine environment.

### **Accomplishments:**

- We have, to date, identified three groups of emerging contaminants of concern for study. These include the brominated flame retardants; pharmaceutical compounds; and current use pesticides.
- Developed analytical methods for the quantification of several pyrethroid insecticides in estuarine waters. These included resmethrin, bifenthrin, and permethrin.
- Developed analytical methods for the quantification of antifouling biocides (e.g. Irgarol) in estuarine/marine sediments.
- Expanded sampling efforts to characterize the distribution of antifouling biocides in water and sediments of coastal waters from various geographic locations (California, Puerto Rico, South Carolina).
- Developed analytical methods for the quantification of brominated flame retardants (PBDEs) in estuarine/marine sediments and began to assess the distribution of these contaminants in the estuarine environment (South Carolina, Chesapeake Bay, Gulf of Mexico, South Atlantic Bight).
- Evaluated the the presence of pharmaceutical compounds in sewage effluent and their potential movement into estuarine waters.
- Evaluated the toxicity of simvastatin, irgarol, and PBDE-47 in adult and larval grass shrimp and juvenile clams and the toxicity of irgarol in algae and the mud snail.
- Evaluated biomarkers of exposure (glutathione, lipid peroxidase and cholesterol) for all three compounds in adult and larval grass shrimp.
- Continued evaluations of NMR-based metabonomics as a potential biomarker of contaminant exposure and/or effects in fish using a model toxicant (chlorpyrifos).
- Began evaluations of NMR-based metabonomics as tool in dolphin health assessments.

### **Publications/Presentations:**

M.Fulton. Emerging Marine Contaminants Research at the NOAA Center of Excellence for Oceans and Human Health at the Hollings Marine Laboratory. Ocean Sciences Meeting. Honolulu, HI. February 2006.

D. Bearden, E. Pollock. Metabolic profiling of dolphins from two sites along the Atlantic Coast. Poster presentation at 26th Annual Society of Environmental Toxicology and Chemistry, Baltimore, MD. November 2005.

M.DeLorenzo, L. Serrano. Mixture toxicity of the antifouling compound irgarol to the marine phytoplankton species *Dunaliella tertiolecta*. Platform presentation at the 26th annual Society of Environmental Toxicology and Chemistry Meeting, Baltimore, MD. November 2005.

M. Fulton. Development of an emerging marine contaminant research program at the NOAA Center of Excellence in Oceans and Human Health at the Hollings Marine Laboratory. Platform presentation at the 18<sup>th</sup> Biennial Conference of the Estuarine Research Federation, Norfolk, VA. October 2005.

P. Key, J. Hoguet, L. Reed, M. Fulton. Lethal and sublethal effects of simvastatin on two grass shrimp (*Palaemonetes pugio*) life stages. Platform presentation at 26th Annual Society of Environmental Toxicology and Chemistry, Baltimore, MD. November 2005.

E. Pollock, D. Bearden. Effect of chlorpyrifos exposure on the metabolome of mummichogs. Poster presentation at 26th Annual Society of Environmental Toxicology and Chemistry, Baltimore, MD. November 2005.

Y. Sapozhnikova, E. Wirth, F. Clum, M. Fulton. Antifouling biocides in the marine environment. Carolinas SETAC, Raleigh, NC. March 2005. Platform presentation at 26th Annual Society of Environmental Toxicology and Chemistry, Baltimore, MD. November 2005.

DeLorenzo, M.E., Serrano, L. (In Press) Mixture toxicity of the antifouling compound irgarol to the marine phytoplankton species *Dunaliella tertiolecta* J. Environ. Sci. Health, Part B

Finnegan, M.C., Pittman, S., DeLorenzo, M.E. Effects of two antifoulant paint compounds, irgarol 1051 and copper, on the mud snail, *Ilyanassa obsoleta*. Southeastern Estuarine Research Society Fall Meeting, 19-21 October 2006, Savannah, GA.

Pollock, E.C., Chung, K.W., Hoguet, J., Key, P., Fulton, M., Bearden, D.W., Metabolomic studies on tidal creek fish *Fundulus heteroclitus*. Poster presentation at the 2<sup>nd</sup> Metabolomics Society Annual Meeting, Boston, MA, June 2006.

Pollock, E.C., Fair, P.A., Bearden, D.W., Metabolic profiling of dolphins from two sites along the Atlantic Coast. Poster presentation at the 2<sup>nd</sup> Metabolomics Society Annual Meeting, Boston, MA, June 2006.

Manuscript in preparation: Metabolic profiling of Atlantic Coast dolphins.

Manuscript in preparation: Metabolic studies on *Fundulus Heteroclitus*.

### **Application/Technology Transfer relevant to OHH Strategic Goals**

#### **1.0 Scientific Research and Application**

Increase the understanding of the causal relationships between humans, ocean processes, marine ecosystem health and human health outcomes.

***The Emerging Contaminant research project increases our understanding of these relationships by providing information on the***

*distribution and threshold effects concentrations of these contaminants of concern in estuarine ecosystems. This research will serve as a framework for the development of a comprehensive risk assessment for emerging contaminants in the estuarine/marine environment.*

2.0 Public Information and Outreach

Deliver useful and timely information, tools, methodologies, technologies to end-users and targeted audiences, on the relationship between oceans and human health focused on reducing human health risks.

*As demonstrated by the publications and presentations cited above, this project is disseminating timely information on methodologies and assessments of the potential impacts of Emerging Marine Contaminants to a variety of targeted audiences and end-users. Additionally, we are collaborating with a variety of other Federal and State agencies on emerging contaminant issues. Specific examples include our collaboration with the California Department of Pesticide Regulation to determine the distribution of Irgarol and other antifouling agents in California marinas. The information we provide on these compounds will be useful for their Risk Assessment process. We are also collaborating with other Federal agencies (EPA, USGS, FDA, CDC) on the development of a document that will describe a strategy for addressing Environmental Health concerns of pharmaceutical compounds in the environment.*

3.0 Capacity Building

Strengthen capacities in Oceans and Human Health to execute research, coordination, outreach, information dissemination, and technology transfer.

*We have improved our analytical capabilities for detecting and quantifying emerging contaminants including brominated flame retardants, antifouling compounds, and current use pesticides and are beginning to investigate their distribution in the marine/estuarine environment. In addition, we have compiled significant bioeffects data for these compounds in a number of model estuarine organisms. We are disseminating this information through the scientific literature as well as providing it directly to environmental managers. We have established collaborations with other Federal agencies (eg. USGS) that will enhance research coordination.*

**Project abstract:**

Many contaminants currently entering estuaries have not been well characterized due to the lack of widely available methodologies for their detection and quantification. These contaminants include a wide variety of compounds such as pharmaceuticals, industrial byproducts (eg. flame retardants), and pesticides. New, potentially hazardous compounds will continue to emerge over time and it is imperative that NOAA have both the

infrastructure and research initiatives to assess their potential to impact both ecosystem and human health.

The Emerging Marine Contaminants Program is developing the analytical methods necessary to measure these contaminants and is beginning to characterize their distribution in estuaries. Additionally, this program is evaluating the potential of these contaminants to cause toxicity in a variety of model estuarine species as well as the pathways by which they may pose a risk to human health. The results obtained by this research initiative will provide a framework for the development of a comprehensive risk assessment for these emerging contaminants in the estuarine/marine environment.

**Unresolved Issues:**

- Need for consistent funding to support OHH Research.
- Our need to respond in the aftermath of Hurricane Katrina may cause some delays in the completion of some tasks described in our SOWs. While this may be perceived as a negative impact, our ability to respond to post-Katrina issues has been enhanced by the OHH initiative (eg. our ability to measure PBDEs post-Katrina was a result of methods development supported by OHH).
- Our ability to prioritize emerging contaminants for study remains an issue. We are continuing to develop and refine our list, but it will continue to change and grow over time. We are continuing to participate in workshops and discussions with other Federal Agencies (eg., NIST, EPA, USGS) to prioritize our research.

**Budget Report Years 1-3:**

Category	Year 1		Year 2		Year 3		Total	
	OHH Funds	Matching	OHH Funds	Matching	OHH Funds	Matching	OHH Funds	Matching
Labor	100,000	105,000	309,601	110,000	90,000	175,000	499,601	390,000
Supplies	7,093	20,000	10,000	15,000	0	25,000	17,093	60,000
Total	107,093	125,000	319,601	125,000	90,000	200,000	499,601	450,000